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## The 200-Curie Cobalt-60 Gamma-Ray Irradiation Facility for Textile and Polymer Studies

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A 200-Curie cobalt-60 gamma-ray irradiation facility for textile and polymer studies was installed at the Institute for Chemical Research, Kyoto University in 1969. This facility is composed of a source container and gamma-ray irradiation system. As this facility is equivalent to so-called "gamma cell", can be used even in experimental room without any special buildings or constructions for prevention of leakages. The leakage of gamma rays of this facility is controlled by lead shieldings below 0.5 mr/h at the surface of the facility.

### I. INTRODUCTION

Recently, studies using high energy irradiation are spreading in the field of high polymer chemistry and valuable results are now being obtained in both

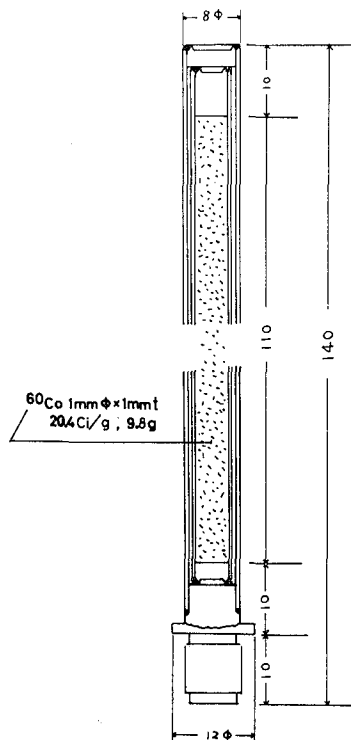
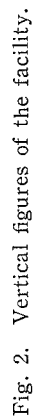


Fig. 1. Source capsule.

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properties or molecular structures such as crystallinity and orientation of some crystalline polymers, for examples polyethylene and polypropylene, are studied in this laboratory using high energy irradiation.

For these purposes, cobalt-60 200-Curie gamma-ray irradiation facility which is relatively simple structure and easy to handle is introduced in this laboratory. Outline of this facility is described briefly in this paper.

### II. OUTLINE OF THE FACILITY

#### II-1 Cobalt-60 source

Cobalt-60 source manufactured by General Electric Co., U. S. A., is a  $1\text{mm}\phi \times 1\text{mm}$  pellet type with specific radioactivity of  $20.4\text{Ci/g}$ . Weight of a pellet is about 7 mg. The cobalt-60 pellets of total 9.8 g are sealed in a stainless steel capsule shown in Fig. 1.

#### II-2 Structure

This facility may be divided into three parts.

1. Cobalt-60 source container,
2. Source-driving device,
3. Irradiation box.

Figure 2 shows the vertical figure of the facility, and Figs. 3 and 4 are the photographs of the facility. The source container is right side (the position of exposure—normal state) in Fig. 3 and left side (the position of sampling) in Fig. 4, respectively.

#### II-2. a. Source container

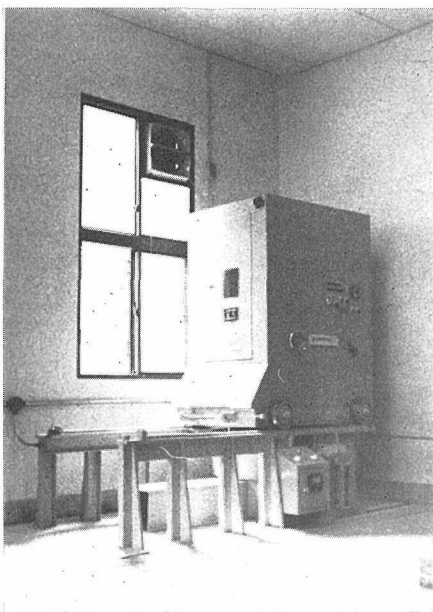


Fig. 3. Photograph of the facility.  
Irradiation state.

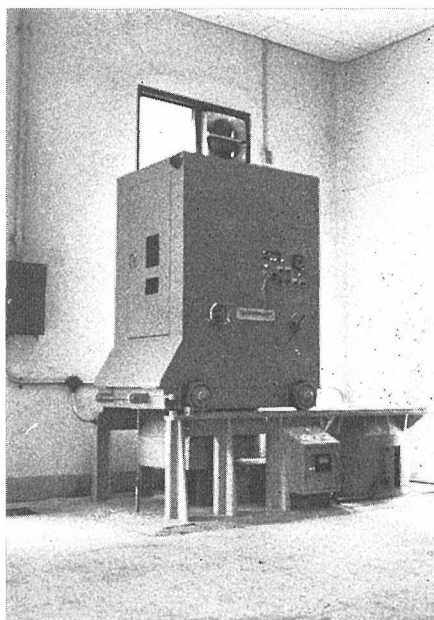


Fig. 4. Photograph of the facility.  
Sampling state.

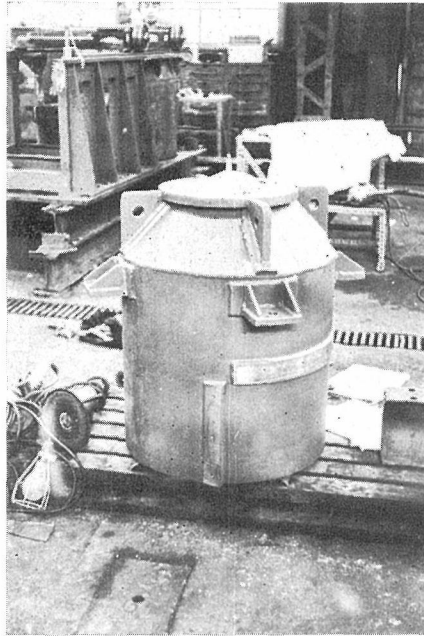


Fig. 5. Photograph of the source container.

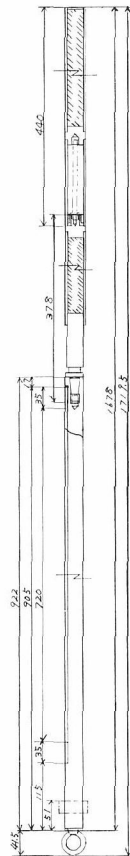


Fig. 6. Source-driving rod.

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This container is approximately cylinder type (Fig. 5) and designed to be used not only as a container for cobalt-60 200-Curie source but also as a transportation container of the source.

Inside of the container is made of stainless steel and outside is of normal iron steel, respectively, and between them lead for leak shielding is packed so as to control surface leakage below 0.5 mr/h. The source capsule is connected with a source-driving rod (Fig. 6). The upper and under sides of the source are packed with lead rods (about 280 mm length) for prevention of leakage toward upper and under directions. The rod containing the source is stored vertically in the center portion of the container, and at the time of exposure, the source capsule together with shielding lead rods are driven down to the bottom of ir-

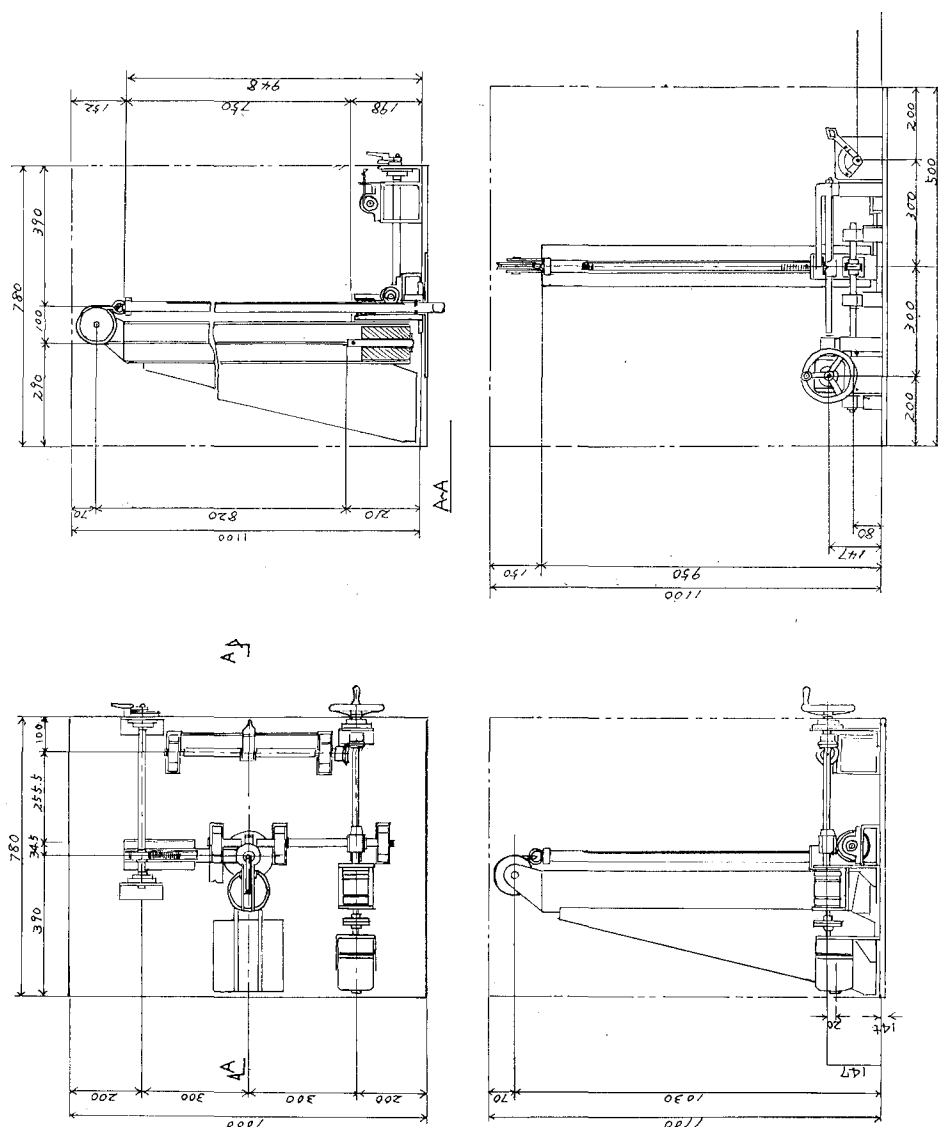


Fig. 7. Source-driving device.

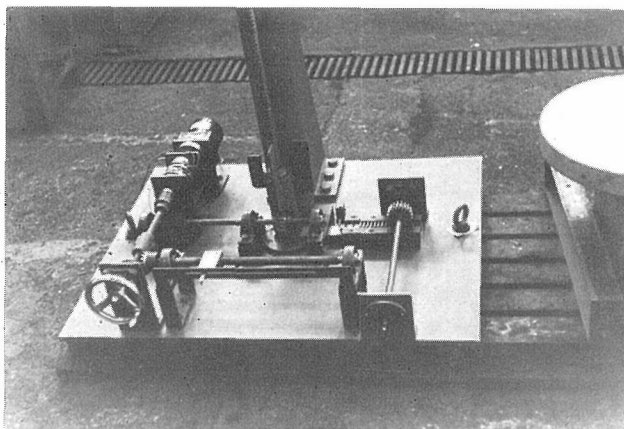


Fig. 8. Photograph of the source-driving device.

radiation chamber by the source-driving device (Fig. 7).

The container is installed on a truck above the irradiation chamber and source driving is possible only when the truck (the container) is at right position above the irradiation box. Putting in and out of samples to be irradiated are carried out after the truck (the container) is moved manually to left side (compare Fig. 3 with Fig. 4).

#### II-2. b. Source-driving device

The exposure and housing of the source are made using an gear-driving mechanism (Figs. 7 and 8), while manual operation can also be conducted through the handle installed on the control panel. The position of the source is indicated both by mechanical indicator and pilot lamps installed on the control panel. It requires about 10 sec to exposure the source from the container to the bottom of the irradiation chamber in the case of electric drive.

#### II-2. c. Irradiation chamber

Size of inner part of the irradiation chamber is about  $30\text{ mm}\phi \times 320\text{ mm}$ . A stainless disc with aluminum sample holders is placed at the bottom of the irradiation chamber. The sample holders are arranged in five concentric circles around the source, as shown in Fig. 10. Temperature in the irradiation chamber is controlled from room temperature to about  $100^{\circ}\text{C}$  by a thermister thermometer and heaters surrounding the chamber. Lead shieldings surrounding the outer side of the chamber are used for prevention of leakage at the time of exposure.

#### II-2. d. Electric circuit

Figure 9 shows electric circuit for the source driving.

### II-3. Dose rate and leakage

Dose rates at some points were measured with the fluoroglass dosimeter (Toshiba FD-R1 fluoroglass). Measuring points and results are shown in Fig. 10 and Table 1, respectively.

Leakages of gamma-rays at the time of exposure were measured using a transistorized GM radiation survey meter (Fujitsu Limited, SM-102). No leakage over  $0.5\text{ mr/h}$  was observed at any points of the surface of the facility.

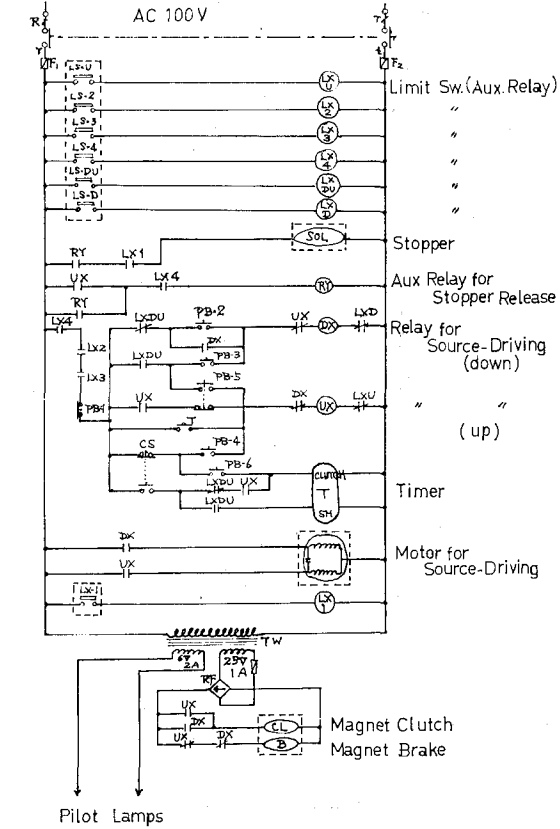


Fig. 9. Figure of electroic circuit for source-driving.

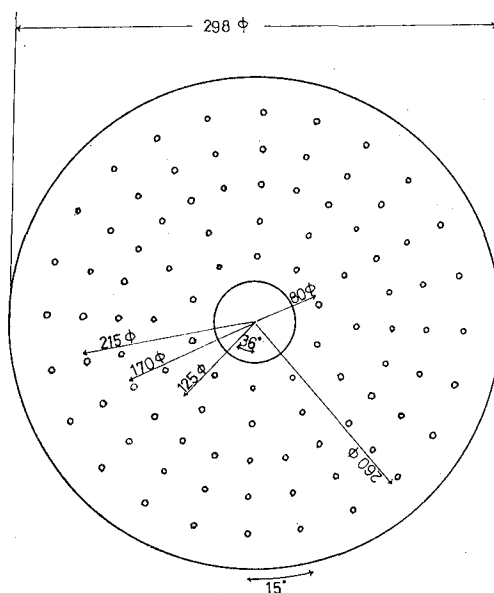


Fig. 10. The points for dose rate determination.



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Table 1. Dose rates measured with fluoroglass dosimeter.

Measuring points			Dose rate $\times 10^4$ (r/h)
Line	No.	Height (mm)	
1 {	1	0	8.26
	6	0	7.74
	1	70	6.29
	6	70	7.90
2 {	1	0	4.15
	7	0	3.95
	1	70	4.20
	7	70	4.46
3 {	1	0	2.52
	13	0	2.56
	1	70	2.63
	13	70	2.89
4 {	1	0	1.55
	14	0	1.57
	1	70	1.99
	14	70	1.90
5 {	1	0	1.10
	14	0	1.09
	1	70	1.16
	14	70	1.34

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